BULL. BOT. SURV. INDIA
Vol. 10, No. 2: pp. 171-176, 1968

FERNS AND FERN ALLIES OF RAJASTHAN—III: HITHERTO UNRECORDED SPECIES OF *OPHIOGLOSSUM* FROM RAJASTHAN

P. L. MITAL

Government College, Ajmer

ABSTRACT

Five species of *Ophioglossum* have been recorded for the first time in Rajasthan, four from Mt. Abu and one from Ajmer. These are *O. reticulatum*, *O. gramineium*, *O. nudicaule*, *O. costatum* and *O. petiolatum* respectively. Their main characters have been described and a key given for their specific identification. The epidermal and stomatal features do not seem to constitute any major features of diagnostic value.

INTRODUCTION

Mount Abu in the State of Rajasthan is situated at 24°36′ N and 72°43′ E and forms the South-Western extremity of the Aravalli range. According to Spate (1957) the Aravalli range may perhaps claim to be the oldest mountain system recognisable as such on the earth's surface.

Abu mountains are mainly composed of greyish, large-grained granites which often contain distinct veins of quartz, trap, green stone gneiss and schist. Fragments of mica and hard crystalline limestone are also met within different parts (*Raizada*, 1954).

Mount Abu, although a part of the Aravalli range, is separated from the main chain by a valley about 24 km wide. The mountain arises abruptly from the flat plains. The total area of irregular plateau at the top of this mountain is about 22 km in length and 3.5 to 7 km in breadth. Mount Abu is the highest point between Himalayas and the Nilgiris and attains a maximum height of 1696 meters above mean sea level at Guru Shikhar.

The annual rainfall of Mount Abu varies considerably from year to year, the average being about 177.8 cm; July to September being the chief rainy months. Sometimes very high (386.65 cm in 1944) or very low (50.19 cm in 1939) rainfall has also been recorded from this area. The climate of this place is never extreme but always moderate. The mean temperature for May is about 26-30°C with a drop of about 9°C at night (*Gupta*, 1957-58).

Due to heavy rainfall, Mount Abu possesses the richest vegetation in the whole of Rajasthan. It is only during rainy months that the ferns mainly flourish and are plentiful in number (*Mital*, 1968). Some species like *Hypodematium crenatum*, *Cheilanthes albomarginata*, *C. farinosa*, *Pteris vittata* and *Marsilea minuta* in ponds, grow all the year round.

A review of the earlier literature (*Mital*, 1968) reveals that the genus *Ophioglossum* without any specific identification was reported from Mt. Abu by Raizada (1954). Recently the author enlisted two species of *Ophioglossum*, one from Ajmer and the other from Mt. Abu (1968). Since then three more species of the genus have been identified from Mt. Abu. It may, therefore, be advisable to mention these and give a description of all the five species of *Ophioglossum* in Rajasthan, namely *O. reticulatum*, *O. gramineium*, *O. nudicaule*, *O. costatum* and *O. petiolatum*. The first four species were collected from Mt. Abu while the last one is from Ajmer.

DESCRIPTION

Ophioglossum reticulatum Linn. Sp. Pl. 1518. 1753; Hook. & Bak. Syn. Fil. 446, 1874; Bedd. Handb. Ferns Brit. Ind. 465, 1892; Clarke in Trans. Linn. Soc. Lond., II, Bot. 1: 586, 1880; Mital in Journ. Bomb. Nat. Hist. Soc. 1968.

Perennial erect herb, 8.5 to 27.2 cm long, root stock cylindric elongated, stoloniferous with many horizontal roots bearing one to two leaves; stipules hairy on root stock; common stipe 3.2 to 7.5 cm long; sterile segment placed below the middle, submembranous or somewhat fleshy, broadly ovate, ovate-orbicular either cordate or broad truncate at base (Fig. 1), acute to blunt at apex, 2.5 to 5.5 cm long and 2.5 to 3.9 cm broad; veins prominent, lax, without midrib but distinctly reticulate, primary veins forming large hexagonal aeroles in which are included net work of many free vein-endings (Fig. 1a), rarely smaller secondary aeroles are formed; spike 1 to 3.5 cm long on a stalk 5.5 to 16.5 cm long and 1 to 2.5 mm broad ; 20 to 33 pairs of sporangia per spike ; spores 34 to 49 μ in diameter.

Distribution : Moist shady places at Mt. Abu (*Mital,* 1968).

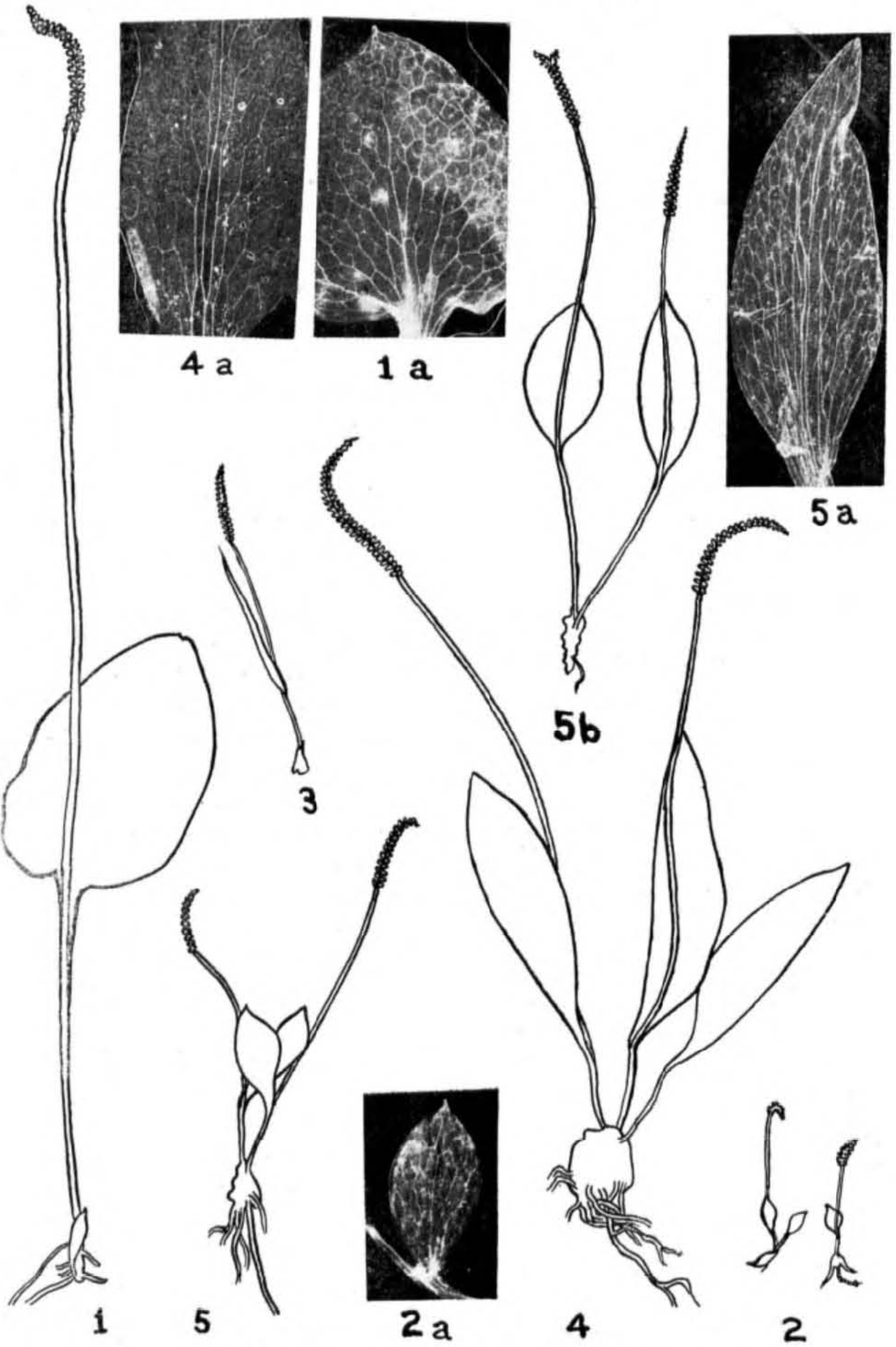


Plate I : Species of *Ophioglossum* in Rajasthan
Figs. 1-5 : 1. *O. reticulatum* L. × nat. size. 1a. The same, showing "*venatio-anaxeti*" with polygonal aerolae and asymmetrically divided free vein-endings. Note secondary aerolae. ×3. 2. *O. nudicaule* L. ×nat. size. 2a. The same, note free vein-endings in submarginal aerolae. ×3. 3. *O. gramineium* Willd. ×nat. size. 4. *O. costatum* R. Br. Note the cormatous rhizome, fibrous roots. × nat. size. 4a. The same, note regular hexagonal primary and secondary aerolae with symmetrically bifurcated free vein-endings. × 3. 5. *O. petiolatum* Hk. Note bifurcated spike in fig. 5b. ×nat. size. 5a. The same, showing "*venatio-anaxeti*" with elongated aerolae. ×3.

Ophioglossum gramineium Willd. in Act. Erf. 18, tab. 1, fig. 1, 1802; Bedd. Handb. Ferns Brit. Ind. Suppl. 108, 1892; Balakrishnan et. in Bull. Bot. Surv. Ind. 2: 337, 1960; Mahabale in Bull. Bot. Surv. Ind. 4: 71, 1962. *O. lusitanicum* Hook. & Bak. Syn. Fil. 445, 1868.

Plant erect, 7 cm long, root stock small cylindric with few roots and bearing single leaf; common stipe 1 cm long; sterile segment placed below the middle, submembranous, narrow-linear with acuminate apex (Fig. 3), 3.5 cm long and 2 mm broad; venation prominent, no midrib, all veins spring from the base of the lamina, reticulated upwards, no free vein-endings in the elongated aeroles; spike 1.7 cm long on a stalk 3.3 cm long; 14 pairs of sporangia per spike; spores could not be measured because of dehisced spike.

Note: Description is based only on a collection of single specimen.

Distribution: Near Palanpur point, Mt. Abu, *Miss Kamlesh Sharma*, 0/130, 19th September 1967. Extremely difficult to recognise because of the grass like leaf and found mixed along with grass on exposed rock.

Ophioglossum petiolatum Hook. Exotic Flora, 1: 56, 1823; Mital in Journ. Bomb. Nat. Hist. Soc. 1968. *O. cordifolium* Roxb., Wall., List n. 47, 1828. *O. pedunculosum* Prantl in Jahrab Bot. Gart. Berlin, 3: 328, 1884 (non Desvaux 1811); Holt. Ferns Malaya, 39, 1960; Mahabale in Bull. Bot. Surv. Ind. 4: 71, 1962. *O. pedunculatum* Nakai in Bot. Mag. Tokyo, 39: 193, 1925.

Plant is of slender habit, perennial erect herb 2.8 to 13 cm long; root stock cylindric, elongate, slightly tuberous bearing brownish persistent scale like sheaths, with many roots; leaves one to two, common stipe 6 mm to 2.6 cm long; sterile segment placed below the middle, membranous; lanceo-ovate blade, narrowed much more acuminate or acute at apex (Fig. 5) 1.2 to 4.8 cm long and 6 mm to 2.2 cm broad; venation distinct, lax and reticulate but no midrib, aeroles elongated with free vein-endings (Fig. 5a); spike 5 mm to 2.1 cm long on a stalk 1.5 to 8 cm long, the spike sometimes becomes bifurcated (Fig. 5b) thus showing an abnormal feature; 12 to 20 pairs of sporangia per spike; spores 34 to 47 μ in diameter.

Distribution: Common in grass along water channels in rainy season on hillocks or at the base of the hillocks in Ajmer (*Mital*, 1968). Plants small sized rather inconspicuous. According to Clausen (1938) *O. petiolatum* is closely related to *O. reticulatum* and in certain parts of the world, notably India, China and Mexico, the two populations seems to intergrade to certain extent.

Ophioglossum nudicaule L. f. Suppl. p. 443, 1781; Bedd. Handb. Ferns Brit. Ind. 464, 1892; Balakrishnan et. in Bull. Bot. Surv. Ind. 2: 338, 1960; Mahabale in Bull. Bot. Surv. Ind. 4: 71, 1962. *O. parvifolium* Hook. and Grev. Bot. Misc. 3: 218, 1833; Bedd. F. S. I. t. 71, 1863. *O. luersseni* Prantl, Ber. deut. botsch. Ges. 1: 352, 1883. *O. moluccanum* f. *pumilum* Raciborski, Nat. Tijdschr. Ned. Ind. 59: 237, t. 2. f. 2-3. 1900. *O. pumilum* (Rac.) van Alderwerelt van Rosenburgh, Malay Ferns Suppl. 1: 453, 1916.

Plant is of slender habit, erect herb, 2.5 to 4 cm long; root stock cylindric, slightly tuberous, bearing persistent scale like sheaths, with few roots, leaves one to two; common stipe 4 to 6 mm long; sterile segment placed at the base (Fig. 2), submembranous, ovate, slightly attenuate at the base, acute or mucronate at apex, 7 mm to 1 cm long and 5 to 7 mm broad; venation obscurely reticulate without midrib (Fig. 2a), aeroles elongated, marginal and submarginal aeroles have few divaricating (free vein-endings) veinlets; spike 5 mm long on a long stalk 1.5 to 3 cm long; 3 to 10 pairs of sporangia per spike, spores 29 to 42 μ in diameter.

Note: Description is based only on a small collection of few plants.

Distribution: Kodra Dam, Mt. Abu, *Anil Kumar Deedwania*, 0/131, 20th September, 1967. Plants are extremely small and very difficult to recognise. Plants are found on the exposed rocks mixed with grass.

Ophioglossum costatum R. Br. Prod. Fl. Nov. Holl. 163, 1810; Balakrishnan et. in Bull. Bot. Surv. Ind. 2: 337, 1960. *O. pedunculosum* Desv. Berl. Mag. 5: 306, 1811. *O. fibrosum* Schum. K. Dank. vid. Afh. 4: 226, 1827; Bedd. Handb. Ferns Brit. Ind. 465, 1892; Mahabale in Bull. Bot. Surv. Ind. 4: 71, 1962. *O. wightii* Hook. and Grev. Bot. Misc. 3: 218, 1833. *O. brevipes* Bedd. F.S.I. t. 72, 1863.

Perennial erect herb, 4.5 to 16 cm long; rootstock rounded, massive tuberous with numerous fibrous roots; a circular ridge or rim on the top of the rhizome surrounds a pit-like depression from

TABLE I : *Epidermal characters in the leaves of Ophioglossum*

Species	UPPER					LOWER				
	Size of stomata in μ	Size of stomatal pore in μ	Orientation and frequency of stomata per mm^2	Epidermal cells in μ	Nature of epidermal cell walls	Size of stomata in μ	Size of stomatal pore in μ	Orientation and frequency of stomata per mm^2	Epidermal cells in μ	Nature of epidermal cell walls
1. *O. reticulatum*	25-35 × 15-25	10-20 × 5-10	Irregular, 9	± Isodiametric, 85-155 × 75-115	Less sinuous	25-40 × 20-30	10-20 × 5-10	Irregular, 13	Long, 125-275 × 90-135	Sinuous
2. *O. petiolatum*	15-25 × 15	5-15 × 5	Irregular, 43	Long, 50-100 × 30-50	Sinuous	20-25 × 15-20	5-15 × 5-10	Irregular, 52	Long, 50-165 × 30-60	Sinuous
3. *O. costatum*	20-30 × 5-25	10-15 × 0-10	Irregular, 60	Long, 35-100 × 25-40	Sinuous	20-35 × 15-25	10-20 × 5-10	Irregular, 57	Long, 50-100 × 30-70	Sinuous
4. *O. nudicaule*	20-25 × 15	10-15 × 5	Irregular, 8	Long, 70-170 × 35-45	Sinuous	20-30 × 15-25	10-15 × 5-10	Irregular, 8	Long, 80-185 × 40-55	Sinuous

which arise one to five leaves; common stipe 1.3 to 2.6 cm long; sterile segment placed below the middle, somewhat leathery, elliptic-lanceolate, cuneate or attenuate at the base, acute or apiculate at apex (Fig. 4), 2.8 to 7.3 cm long and 8 mm to 1.9 cm broad; a band of prominent median veins in a groove, venation reticulate, double with primary veins forming large hexagonal aeroles in which are included net works of many free vein-endings with smaller secondary aeroles (Fig. 4a); spike 1.1 to 4.4 cm long on a stalk 1.5 to 12.6 cm long; 20 to 40 pairs of sporangia per spike; spores 23 to 44 μ in diameter.

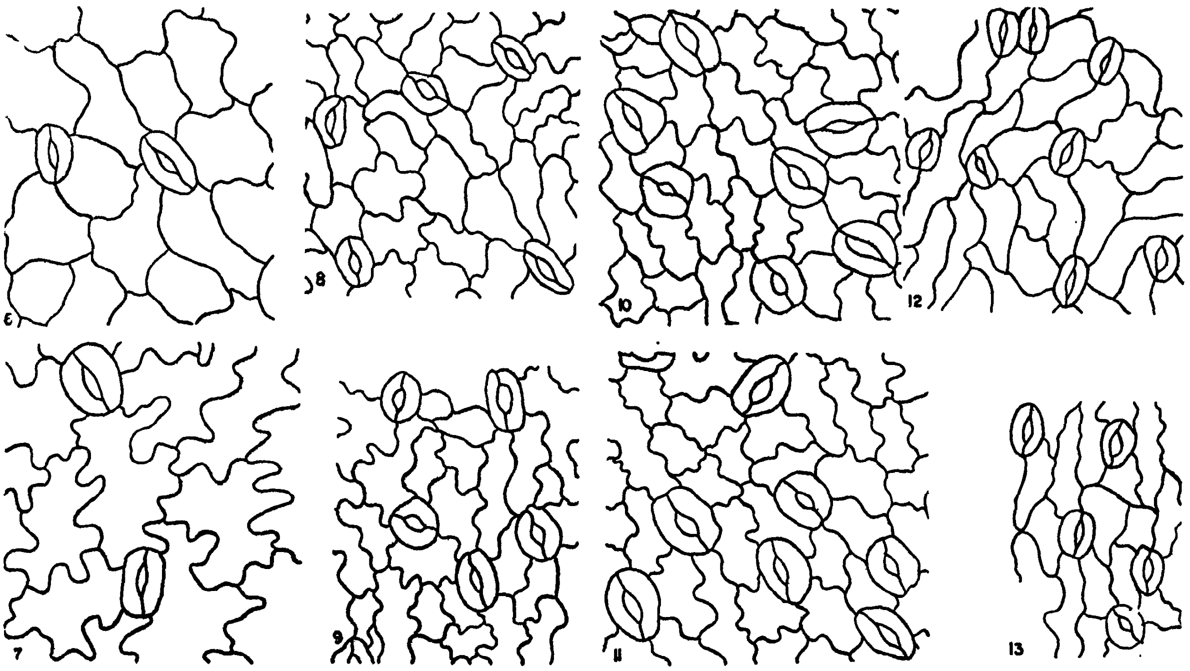
Distribution: Adhar Devi, Mt. Abu, *Gynendra Sharma and party*, 0/132, 21st September, 1967; Trawartall, Mt. Abu, *P. N. Mathur and party*, 0/133, 21st September, 1967. On exposed rocks and moist shady places respectively; village Bahrore tehsil Kotputli, *G. P. Sharma*, Sept.-Oct., 1967.

KEY TO THE SPECIES

I Rhizome globose, corm-like, massive, tuberous; leaf with a band of prominent median veins in a groove; principal veins form large hexagonal primary aeroles enclosing smaller secondary aeroles. ... *O. costatum*

II Rhizome not globose, but elongate, cylinderic, tuberous, leaf without midrib; principal veins form aeroles not enclosing the smaller ones.

- (*a*) Aeroles elongated.
  - 1. Marginal aeroles with free vein-endings and aeroles regular.
    - Leaf blade ovate, acute ... *O. nudiculae*
    - Leaf blade narrow-linear, acuminate ... *O. gramineium*
  - 2. Aeroles with "*venatio-anaxeti*" i.e. free vein-endings and irregular.
    - Leaf blade lanceo-ovate, acuminate ... ... *O. petiolatum*
- (*b*) Aeroles broad, hexagonal and irregular with "*venatio-anaxeti*"
  - Leaf blade cordate or broad truncate at base ... ... *O. reticulatum*



Figs. 6-13. Stomata and epidermis of leaf in Rajasthan species of *Ophioglossum* × ac. 33.
Fig. 6. *O. reticulatum*—upper epidermis. 7. The same—lower epidermis. 8. *O. petiolatum*—upper epidermis. 9. The same—lower epidermis. 10. *O. costatum*—upper epidermis. 11. The same—lower epidermis. 12. *O. nudicaule*—upper epidermis. 13. The same—lower epidermis.

In order to distinguish the species further, epidermal characters of the leaf such as stomatal position, epidermal cell walls and their cells were studied. All these characters of upper and lower epidermis have been tabulated. It appears that there are some minor specific differences in the frequency in the size of stomata and stomatal pores as well as in the epidermal cells. The size of the stomata in the four species here examined varies from 15 × 15 to 40 × 30 μ, the size of the pores in the stomata varies from 5×5 to $20 \times 10\,\mu$ while the nature of the epidermal cells is sinuous in all species, the upper and lower epidermal cells, however, differ in the individual species in shape and size (Table I and figs. 6-13).

ACKNOWLEDGEMENTS

The author is indebted to Prof. K. M. Gupta, University of Jodhpur, for his guidance. His sincere thanks are due to Dr. B. V. Ratnam, Head of Botany Department, for placing the entire collection of the genus *Ophioglossum* in Rajasthan at his disposal and also to Principal Dr. P. N. Mathur, Government College, Ajmer for necessary facilities.

REFERENCES

BALAKRISHNAN, N. P., K. THOTHATHRI AND A. N. HENRY. Some Indian *Ophioglossum*—Taxonomy and distribution. *Bull. bot. Surv. India* 2: 335-339, 1960.

BEDDOME, R. H. *A handbook of the Ferns of British India, Ceylon and Malay Peninsula with Supplement.* 1892.

CLARKE, C. B. A review of Ferns of northern India. *Trans. Linn. Soc. Lond.* II, *Bot.* I: 426-611, 1880.

*CLAUSEN, R. T. A Monograph of the Ophioglossaceae. *Mem. Torrey bot. Cl.* 19(2): 1-177, 1938.

GUPTA, O. P. *Mount Abu.* Sasta Sahitya Press, Ajmer, 1957-58.

HOOKER, W. J. AND J. G. BAKER. *Synopsis Filicum.* London, 1868.

MAHABALE, T. S. Species of *Ophioglossum* in India; their taxonomy and phylogeny. *Bull. bot. Surv. India* 4 : 71-84, 1962.

MITAL, P. L. Ferns and Fern allies of Rajasthan—II: A systematic survey of Ferns and Fern allies of Rajasthan with special reference to new records. *J. Bomb. nat. Hist. Soc.* 1968. (in press)

RAIZADA, M. B. A Botanical visit to Mt. Abu. *Indian For.* 80: 207-215, 1954.

SPATE, O. K. *India and Pakistan.* London, 1957.

---

*Not seen in original